TITLE OF THE INVENTION

Data Bus for a Plurality of Nodes

BACKGROUND AND SUMMARY OF THE INVENTION

This application claims the priority of German

Patent Document 198 10 288.7 filed March 10, 1998

and PCT/EP99/01172 filed February 23, 1999, the

disclosures of which is expressly incorporated by

reference herein.

The invention relates to a data bus for a plurality
of nodes which exchange data messages among one
another via at least one electrical line. The line
may be a component of a star coupler. Such a data
bus is known from the previously unpublished German
patent application 19720401. [With regard to the
circuitry structure of the data bus, this document
does not contain any concrete information.]

The circuitry of such a data bus may be implemented
in the form of an open collector circuit. An open
collector circuit has the disadvantage that, at high
transmission rates and with many bus nodes, a
relatively low resistance must be used as the
collector resistance in order to obtain sufficient
edge steepness of the signal messages which are
present in pulse form. This leads to high currents
and high power dissipation and the necessity of
using power transistors and resistors [as well as to
high power dissipation].

A further problem results [if] when at least one
part of the nodes supplies optical messages.

REPLACEMENT SHEET (RULE 26)

Particularly if the number of bus nodes is large, signal amplification is required to supply the messages in an adequate quality to all nodes. For this purpose it is suitable to convert the messages into electrical form, to amplify them and to reconvert them into optical form. However, this double conversion with additional signal amplification, however, causes signal distortions that reduce data bus efficiency.

For a data bus designed as an open collector circuit, it is known in the art to provide signal shaping devices (cf. US 5,684,831 A). Such a <u>signal sloping</u> device [is provided] for each node[. This] results in high circuit complexity, particularly if there are many nodes.

The object of the invention is to create a data bus [of the initially mentioned type,] which provides interference-free bus communication with low circuit complexity even [if the] <u>for a large</u> number of optical bus nodes [is large].

[The invention attains this object by means of the features of Claim 1.]

The invention [essentially] consists of [the] <u>a</u> logic decision gate and the signal conditioning circuit and their interaction. The decision gate does not require complex signal shaping devices for its use[.] <u>because it</u> [It] transmits the signals in their unchanged form. Moreover, the power requirement is low even if the number of nodes is large. The logic decision gate also makes it possible [drastically] to <u>significantly</u> reduce the

circuit complexity. It is only necessary to arrange a single signal conditioning circuit which models the output signal of the decision gate with regard to the pulse shape between the decision gate and the inputs of the nodes.

[This can consist of matching the] The shape of the output signal is matched to the shape of the input signal or of an adaptation as described in US 5,684,831 A. The rising edges are flattened to make it possible to distinguish the useful signals from high-frequency noise signals with extreme edge steepness.

Embodiments of the invention are possible both with nodes that supply electrical data messages as well as with nodes that generate optical data messages. The latter nodes are connected to the data bus via opto-electric transducers in such a way that the signal outputs of the nodes are each routed to the decision gate via a transducer of this type, and the output of the decision gate is routed to the inputs of the nodes via a common electro-optical transducer or via individual transducers of this type.

[The invention will now be explained in more detail by means of the drawing in which]

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 schematically shows the structure of a data
bus according to the invention, which achieves
reliable bus communication for a plurality of bus
nodes with little circuit complexity, and

Fig. 2 is a further embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[A] The data bus [of which a detail is] shown in
Figures 1 and 2 serves to connect nodes to one
another. [which] The nodes supply optical messages.
The messages of the nodes (for reasons of clarity,
Fig. 1 shows two nodes T_n and T_{n+1}) are routed as
input signals to the inputs of opto-electronic
signal transducers S/E_n and S/E_{n+1}. The electrical
output signals (Di_n, Di_{n+1}) of [these] the
transducers are linked to an AND gate 1. The number
of inputs and outputs of the gate corresponds to the
number of the bus nodes. The output 2 of the AND
gate 1 drives all the inputs (Do_n, Do_{n+1}) of the
transducers S/E_n and S/E_{n+1}. The [latter] transducers
supply pulse-shaped optical output signals, which
deliver these messages to the nodes via optical
transmission segments [(not shown)].

In this manner, each node receives all the messages
sent by the other nodes as well as its own message
in return. [As mentioned above, the] The AND gate 1
has a substantially lower power requirement than the
initially mentioned open collector circuit.

[Also shown is the use of a] A signal conditioning
device SA is positioned on the output of the AND
gate 1. During the conversion of an electrical
signal into an optical signal, pulse distortion

occurs. This is caused, for example, by the fact
that threshold tracking of an optical receiver
cannot occur in an infinitely short time, or by
nonlinearities of the characteristics of optical
components.

In the system shown, pulse distortions on the order
of 15 - 20 ns are expected per optical transmission
segment with one opto-electric respectively electro-
optic transducer each. Since the nodes are connected
via two transmission segments each, this pulse
distortion adds up to 30 - 40 ns in the worst case.
For a target data rate of 10 Mbit/s and, for
example, NRZ (non-return-to-zero) coding, the bit
time is 100 ns. Due to the pulse distortion, a bit
can "shrink" to a duration of 60 - 70 ns. The
distortion adds up to 30% of the signal length. As a
result, a complex sampling process with at least 8
times sampling must be used, which is furthermore
sensitive to crystal jitter.

Through the use of signal conditioning SA at the
output of the AND gate in the [star coupler] data
bus, [it is achieved that] the NRZ coded signals are
returned into a 100 ns bit time form without pulse
distortion. This makes it possible, for example, to
eliminate signal shape distortions, such as may be
generated by opto-electric transducers (S/En,
S/En+1).

For signal conditioning in the SA device, it is
possible to use, for example, the same sampling
method as that employed for the individual nodes. It
is also possible to use a special signal

conditioning process that takes into account special boundary conditions in the data bus.

As a result, data transmission becomes substantially more robust. Short glitches can be filtered out. The sampling method requirements in the individual nodes can be set lower or the tolerance to pulse distortions on a transmission segment [increases] can be increased. The sampling method is clearly less susceptible to crystal jitter. With identical robustness, lower frequency crystals can be used, which provides cost advantages.

The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.